Kinematic Equations

- Solve for x, v, a and t if we know other variables
- Constant acceleration
- Variables:
  - t - time
  - v - velocity
  - a - acceleration
  - x - position
  - Subscripts used for initial (i) and final (f) values: x_i x_f

Kinematic Equations

1) $v_f = v_i + at$

2) $x_f = x_i + v_i t + \frac{1}{2} a t^2$

3) $v_f^2 = v_i^2 + 2a(x_f - x_i)$

4) $v_{av} = \frac{v_f + v_i}{2}$

Using Equation (1)

- A space shuttle is accelerating at a constant rate of **24m/s^2**. If it had an initial velocity of **680m/s**, how fast will it be going after **20s**?

1) $v_f = v_i + at$

Known	**Unknown**
$v_i = 680\frac{m}{s}$	$v_f = ?$
$a = 24\frac{m}{s^2}$	
$t = 20s$	

Using Equation (2)

- A car, beginning at rest, constantly accelerates at **2m/s^2** for **30s**. After **30s** how far will the car have traveled?

2) $x_f = x_i + v_i t + \frac{1}{2} a t^2$

Known	**Unknown**
$x_i = 0$	$x_f = ?$
$v_i = 0$	
$a = 2\frac{m}{s^2}$	
$t = 30s$	

Using Equation (3)

- An airplane that must reach a speed of at least **27.8m/s** to take off and can accelerate at **2m/s^2** wants to use a runway **150m** long. Can the airplane reach the required speed using this runway?

3) $v_f^2 = v_i^2 + 2a(x_f - x_i)$

Known	**Unknown**
$x_i = 0$	$v_f = ?$
$x_f = 150m$	
$v_i = 0$	
$a = 2\frac{m}{s^2}$	